UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER
DAY, HERNG DER

ART UNIT	PAPER NUMBER
2128	

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13

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

		Application No.	Applicant(s)
Office Action Summary		09/491,353	CIRAK ET AL.
		Examiner	Art Unit
		Herng-der Day	2128

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>*27 January 2004*</u>.

2a)☐ This action is **FINAL.**   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5,9-13 and 16-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,9-13 and 16-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)   4)☐ Interview Summary (PTO-413)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)   Paper No(s)/Mail Date. _____ .
3)☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)   5)☐ Notice of Informal Patent Application (PTO-152)
Paper No(s)/Mail Date *11*.   6)☐ Other: _____ .

DETAILED ACTION

1.   This communication is in response to Applicants' Amendment (paper # 9) and RCE

(paper # 12) to Office Actions dated September 5, 2003 (paper # 7) and January 21, 2004 (paper

10), faxed January 5, 2004, and January 27, 2004, respectively.

1-1.   A request for continued examination under 37 CFR 1.114, including the fee set forth in

37 CFR 1.17(e), was filed in this application after final rejection. Since this application is

eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e)

has been timely paid, the finality of the previous Office action has been withdrawn pursuant to

37 CFR 1.114. Applicants' Amendment (paper # 9) has been entered.

1-2.   Claims 1, 9, and 16-17 have been amended; claims 6-8,14-15, and 24-26 have been

cancelled; claims 1-5, 9-13, and 16-23 are pending.

1-3.   Claims 1-5, 9-13, and 16-23 have been examined and rejected.

Specification

2.   The Examiner thanks Applicants' submitting the publications of Warren and Schweitzer.

It has been placed in the application file.

3.   The objections to the specification in paper # 7 of introducing new matter have been

withdrawn.

Claim Rejections - 35 USC § 112

4.   The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5.   Claims 9-13 and 16 are rejected under 35 U.S.C. 112, first paragraph, as containing

subject matter which was not described in the specification in such a way as to reasonably

convey to one skilled in the relevant art that the inventor(s), at the time the application was filed,

had possession of the claimed invention.

5-1.   Claim 9 recites the limitation "as a set of differential equations" in step (c) of the claim,

which does not appear to have support in the original specification.

5-2.   Claims 10-13 are rejected as being dependent on the rejected claim 9.

5-3.   Claim 16 deletes the limitation "linear" in steps (c), (d), and (e) of the claim, which does

not appear to have support in the original specification.

6.   The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7.   Claims 22-23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for

failing to particularly point out and distinctly claim the subject matter which applicant regards as

the invention.

7-1.   The limitations of dependent claims 22 and 23 have already been recited in the

independent claim 17.

Claim Rejections - 35 USC § 102

8.   The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the

basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

9.   Claim 16 is rejected under 35 U.S.C. 102(b) as being anticipated by Buchanan,

"Schaum's Outline of Theory and Problems of Finite Element Analysis", The McGraw-Hill

Companies, Inc., 1995.

9-1.   Regarding claim 16, Buchanan discloses a system for performing finite element analysis

using subdivision basis functions, including:

(a) means for inputting a mesh comprising a set of data points each having connectivity

to neighboring data points, the mesh defining physical parameters (Fig. 7-11, page 230);

(b) means for specifying an initial state for the mesh (Fig. 7-11, page 230; and problem

7.18, page 231);

(c) means for defining a set of linear differential equations comprising a stiffness matrix

and an external forcing vector (stiffness matrix and load vector, solution 7.18, page 231), at least

one such equation having a fourth order differential operator (the governing equation for plate

bending is a fourth-order differential equation, section 7.7, page 210);

(d) means for solving the set of linear equations as applied to the mesh (results are given,

solution 7.18, page 231);

(e) means for outputting the solution to the set of linear equations as defining a

modification of the initial state of the mesh based on the stiffness matrix and in response to the

external forcing vector (Table 7.4, page 232).

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. Claims 1-2, 4-5, 9-10, 12-13, 17-18, and 20-21 are rejected under 35 U.S.C. 103(a) as

being unpatentable over Groothuis et al., U.S. Patent 5,581,489 issued December 3, 1996, in

view of Applicants' own admission.

11-1. Regarding claim 1, Groothuis et al. disclose a method of performing finite element

analysis on a shell including (abstract; and summary, column 1 line 47 through column 2, line

27):

modeling a geometry of the shell as a mesh (create a mesh for the object to be modeled,

column 4, lines 33-37);

characterizing an environment for the shell, including environmental factors affecting the

mechanical behavior of a modeled shell (materials information, column 4, lines 13-30);

computing a mechanical response of the shell, taking into account a characterized

environment, using a finite element analysis to compute a deformed geometry of the surface

(finite element analysis processor, column 5, lines 30-44; density of the material, column 4, lines

21-30); and

outputting a description of the geometry of the modeled shell as determined from the

computed mechanical response (displays, column 5, lines 47-54).

Groothuis et al. fail to expressly disclose: (1) the shell modeled as a set of partial differential equations, at least one of which having a fourth order differential operator; and (2) the finite element analysis uses smooth subdivision basis functions as shape functions.

However, as described in lines 17-22, page 1 of the specification, Applicants admitted, "The Kirchhoff theory of thin plates and the Kirchhoff-Love theory of thin shells are characterized by energy functionals which depend on curvature; consequently they contain second-order derivatives of displacement. The resulting Euler-Lagrange – or equilibrium – equations in turn take the form of fourth order partial differential equations. It is well-known from approximation theory that in this context, the convergence of finite-element solutions requires so-called C^1 interpolation". In other words, fourth order partial differential equation and its fourth order differential operator are inherent in the Euler-Lagrange equation of thin shell.

As for shape functions, the fundamental concept of the finite element method is well known. Each element is defined using an interpolation function to describe its behavior between its nodes. The shape function is usually the coefficient that appears in the interpolation polynomial and is written for each individual node of a finite element. Therefore, using shape function is necessary and inherent in finite element analysis. Applicants present and discuss prior art shape functions in appendix of the specification (pages 42-44).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Groothuis et al. to incorporate the fourth order partial differential Euler-Lagrange equations and the prior art shape functions discussed in the Applicants' specification to obtain the invention as specified in claim 1 because both having a

fourth order differential operator and using smooth subdivision basis functions as shape

functions are inherent in finite element analysis of thin shell as admitted by Applicants.

11-2. Regarding claim 2, Groothuis et al. further disclose the environment factors includes

loading conditions, material properties, and boundary conditions for the modeled shell (input

data, column 3, lines 58-61; and thermal output data, column 4, line 62 through column 5, line

3).

11-3. Regarding claim 4, Groothuis et al. further disclose the loading conditions include an

indication of thermal loading (thermal output data, column 4, line 62 through column 5, line 3).

11-4. Regarding claim 5, Groothuis et al. further disclose outputting indications of the

characterized environment (output data, column 5, lines 11-29; and displays, column 5, lines 47-

54).

11-5. Regarding claims 9-10 and 12-13, these system claims include equivalent method

limitations as in claims 1-2 and 4-5 and are unpatentable using the same analysis of claims 1-2

and 4-5.

11-6. Regarding claims 17-18 and 20-21, these computer program claims include equivalent

method limitations as in claims 1-2 and 4-5 and are unpatentable using the same analysis of

claims 1-2 and 4-5.

12. Claims 3, 11, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over the

combined teachings of Groothuis et al., U.S. Patent 5,581,489 issued December 3, 1996, and

Applicants' own admission, as applied to claims 1, 9, and 17, and further in view of Buchanan,

"Schaum's Outline of Theory and Problems of Finite Element Analysis", The McGraw-Hill

Companies, Inc., 1995.

12-1. Regarding claim 3, Groothuis et al. disclose a method of generating a model of an object

for use in finite element analysis (abstract). Groothuis et al. suggest the result of a finite element

analysis is to predict the effect on an object of heat transfer, mechanical stress, and thermal stress

(column 1, lines 43-45). However, Groothuis et al. only emphasize the analysis of heat transfer

and thermal stress instead of mechanical stress. Groothuis et al. fail to expressly disclose the

loading conditions include an indication of applied forces.

Buchanan discloses a solved mechanical stress problem to explain the application of the

finite element analysis to plate-bending problems. In the exemplary problem, the square plate is

simply supported with a 1000-lb load applied at the center node (problem 7.18, page 231). It

indicates that including applied forces, therefore, is inherent in solving mechanical stress

problem by finite element analysis.

It would have been obvious to one of ordinary skill in the art at the time the invention

was made to modify the combined teachings of Groothuis et al. and Applicants' admission and to

incorporate the teachings of Buchanan to obtain the invention as specified in claim 3 because

Buchanan discloses in detail the loading conditions include an indication of applied forces,

which is inherent in solving mechanical stress, for example, thin-plate bending, problems.

12-2. Regarding claim 11, this system claim includes equivalent method limitations as in claim

3 and is unpatentable using the same analysis of claim 3.

12-3. Regarding claim 19, this computer program claim includes equivalent method limitations

as in claim 3 and is unpatentable using the same analysis of claim 3.

Applicants' Arguments

13.   Applicants argue the following:

(1) "This amendment to claim 1 should also obviate the rejection under 35 U.S.C. 112,

first paragraph" (page 8, paragraph 3, paper # 9).

(2) "by amending each of claims 1, 9 and 17 to recite additional subject matter that

obviates the rejection" of 103(a) (page 8, paragraph 5, paper # 9).

(3) "nowhere in Buchanan is there any teaching or suggestion of using smooth

subdivision shape functions" (page 9, paragraph 3, paper # 9).

Response to Arguments

14.   Applicants' arguments have been fully considered.

14-1.   Applicants' argument (1) is persuasive. The original claim rejections in paper # 7 under

35 U.S.C. 112, first paragraph, for claims 1-7 have been withdrawn. However, upon further

consideration, claims 9-13 and 16 are rejected for introducing new matter, as detailed in sections

5 to 5-3 above.

14-2.   Applicants' argument (2) is not persuasive because the recited additional subject matter is

inherent in finite element analysis of thin shell as admitted by Applicants.

14-2.   Applicants' argument (3) is moot because using smooth subdivision shape functions is

inherent in finite element analysis of thin shell as admitted by Applicants.

Conclusion

15.   The prior art made of record and not relied upon is considered pertinent to Applicants'

disclosure.

Reference to Stam, "Evaluation of Loop Subdivision Surfaces", SIGGRAPH'99 Course

Notes, August 1999, pages 1-15, is cited as disclosing basis functions.

16.   Any inquiry concerning this communication or earlier communications from the

Examiner should be directed to Herng-der Day whose telephone number is (703) 305-5269. The

Examiner can normally be reached on 9:00 - 17:30.

If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's

supervisor, Kevin J Teska can be reached on (703) 305-9704. The fax phone numbers for the

organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding

should be directed to the receptionist whose telephone number is (703) 305-3900.

Herng-der Day
April 5, 2004

Thai Pham
Patent Examiner
AU: 2128